Abnormal Activity Recognition Using Support Vector Machine

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Abstract- *Intelligent video surveillance is highly useful for intelligence gathering, prevention of crime, the protection of a process, person, group or object, or the investigation of crime by various government organizations. Recognition of any Abnormal Behavior through surveillance camera also gains massive interest amongst the researcher community. In this proposed approach surveillance video is converted into frames, those frames are preprocessed by histogram equalization, and then 2D Gabor features are extracted and given to Support Vector Machine to recognize the abnormal activity. Proposed approach is found highly accurate in case of local events.*

Keywords- Support Vector Machine, Intelligent Video Surveillance, Abnormal Activity Recognition

I. INTRODUCTION

Abnormal Activity or Behavior Recognition is highly essential in public or private places due to increasing rate of crime and terrorism. Any event which stands out from the normal behavior within a particular context is considered as abnormal [5].Video near secure area is considered as an input for the proposed system. Frames are extracted and preprocessed using Histogram equalization, so the resulting frames have higher contrast. Features are extracted from every alternative preprocessed frames using 2D Gabor filter. Extracted features are classified using Support Vector Machine (SVM). SVM is powerful tool used for classification and regression. Proposed method is highly efficient for recognition of abnormal events near secure areas.

II. LITERATURE REVIEW

One well-known approach is used to classify suspicious activities in examination hall. SURF (Speed up Robust Features) is used to extract interest points, and SURF method is also used to match and find the corresponding features [1].In this method object detection algorithms are used to detect faces and hands, while tracking algorithms are used to track the locations of the objects. Interest points of two correlated images are captured and If there is any suspicious activity found, the system will detect the hands and the faces of the subjects and also notify the invigilators by alarm [1]. The workflow of above mentioned approach is shown in figure1 [1].

One another approach is based on an integrated pipeline that incorporates the output of object trajectory analysis and pixel-based analysis for abnormal behavior inference [2].

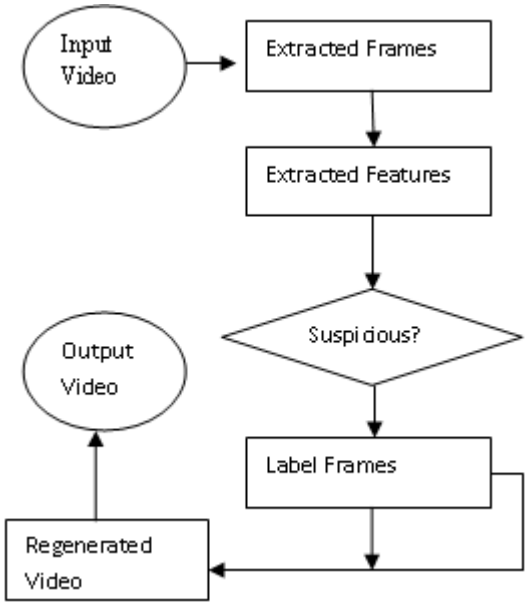

Figure1: Methodology overview [1].

This enables to detect abnormal behaviors related to speed and direction of object trajectories, as well as complex behaviors related to finer motion of each object. By applying this approach on three different datasets, it is found that this approach is able to detect several types of abnormal group behaviors with less number of false alarms compared to existing approaches [2]. The method is shown in Figure2.

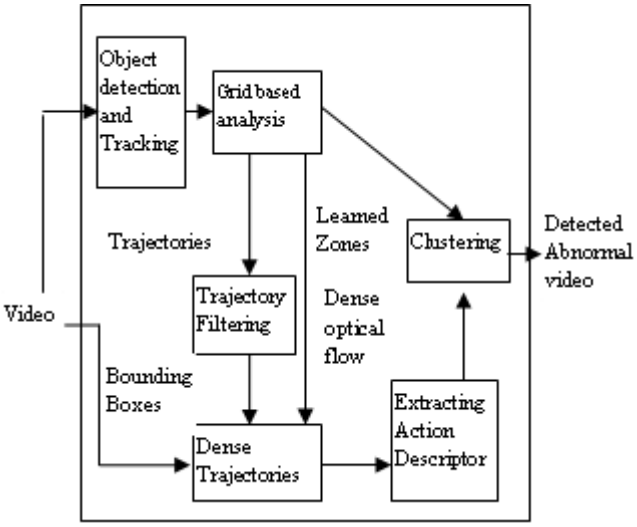

Figure2: The flow diagram of abnormal event detection [2]

One another approach introduces a method for abnormal event detection in video in which the video is divided into a set of cubic patches [3]. A new descriptor for representing the video patches is proposed. This descriptor is created based on the structure similarity between a patch and nine neighboring patches of it [3]. All training normal patches in respect to the proposed descriptor are represented and then modeled using a Gaussian distribution as the reference model. In test phase, those patches which are not fitted to the reference model are labeled as anomaly. The proposed method is evaluated on two UCSD1 and UMN2 popular standard benchmarks. The performance of the presented method is similar to state of the art methods and also is very fast [3].

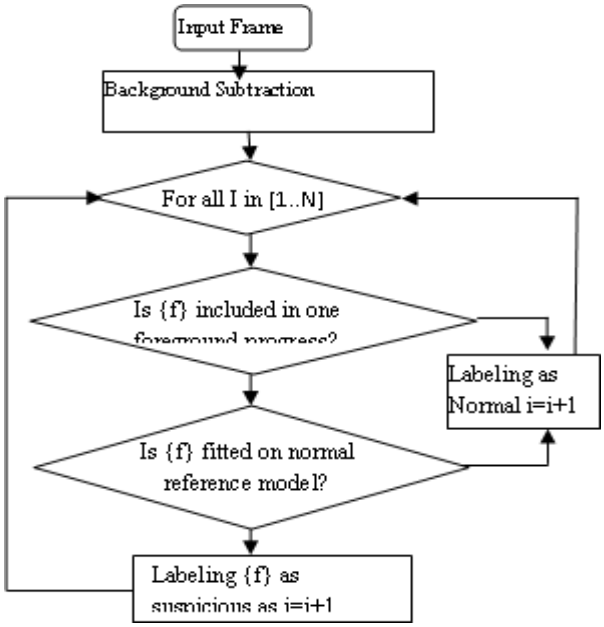

Figure3: Flowchart of the method [3].

III. PROPOSED WORK

The proposed approach is based on Support Vector Machine used for event classification. From the input video frames are extracted and preprocessing is applied on sampled frames. As part of preprocessing Histogram Equalization is applied to enhance the contrast of the input frames. Gabor filter is applied on those preprocessed sampled frames and features are extracted from each one of the sampled frames. Extracted features are given to Support Vector Machine which is used to classify whether the input event is normal or abnormal.

Histogram of a digital image with gray level in the range [0, L-1] is a discrete function $h(r_k) = n_k$, where r_k is the k^{th}gray level and n_k is the number of pixels in the image having gray level r_k. Histogram equalization is a process of adjusting image intensities to enhance the contrast. The intensities can be better distributed on the histogram through these adjustments. Gabor filter have received the significant consideration for feature extraction in various Human computer interaction applications.

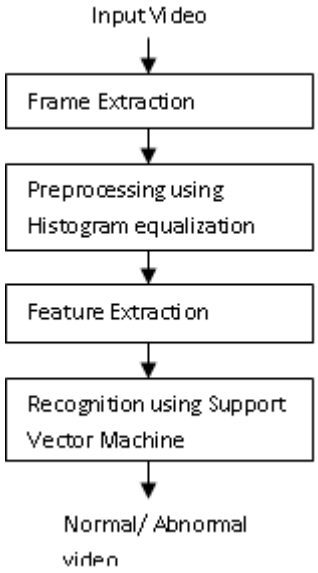

Figure4: Proposed Method

Gabor filters are well suited for motion analysis in abnormal event recognition because these filters have been shown to possess optimal localization properties in both spatial and frequency domain [4]. Multiresolution analysis is possible with Gabor filter by giving coefficient matrices. Illumination changes and noise do not affect the Gabor filter. Here 2D Gabor filter is used for the purpose of feature extraction. Gabor filter is a modulation of a Gaussian function means whose impulse response is defined as a harmonic function multiplied by the Gaussian function [4].

$$G(x,y) = \left(\frac{k^2}{\sigma^2}\right)\left[\exp\left(-\frac{k^2}{2\sigma^2}(x^2+y^2)\right)\right] * \exp\left(i2\pi f(x\cos\theta + y\sin\theta)\right)$$

Where k is a parameter which determines the orientation and scale (frequency) of the Gabor filter.

$$(k_x, k_y) = (k_v \cos\theta_w, k_v \sin\theta_w)$$

Where $k_v = \frac{k_{max}}{f^v}$ v=(0,1,2,3,4) is the different set of frequencies and w=(0,1,2,3,4,5,6,7) is for the different orientation. The values consider for this typical application are $f=\sqrt{2}$, $k_{max} = \frac{\pi}{2}$, $\theta_w = \frac{\pi w}{8}$ and $\sigma = \pi$.

The Gabor window of a size 7 x 7 is used for feature extraction. Features are extracted by simple convolution of the window with the image.

IV. CLASSIFICATION USING SUPPORT VECTOR MACHINE

Support Vector Machine (SVM) is a supervised machine learning algorithm which can be used for both classification and regression challenges. SVM training algorithms builds a model which is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible [4]. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall on. There are two basic approaches 1) Maximum margin classification (linear) and 2) Non linear classification

A. Maximum Margin Classifications

Support Vector Machine classifies the data by constructing a Hyperplane. The one that specifies the largest separation, or margin, between the two classes is considered as the best Hyperplane. The hyper plane is chosen in such a way that the distance from it to the nearest data point on each side is maximized. If such a hyper plane exists, it is known as the maximum margin hyper plane and the linear classifier it defines is known as a maximum margin classifier [4]. Suppose some given data points each belong to one of two classes, and the goal is to decide which class a new data point will be in. In the case of support vector machines, a data point is viewed as a p-dimensional vector (a list of p numbers), and we want to know whether we can separate such points with a p – 1 dimensional hyper plane.

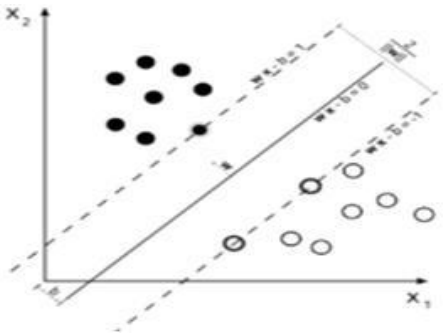

Figure5. Maximum margin hyperplane [4]

B. Multiclass SVM

Multiclass SVM assigns labels to instances by using support vector machines, where the labels are drawn from a finite set of several elements. In order to solve this problem the single multiclass problem is reduced to multiple binary problems. Each of the problems yields a binary classifier, which is assumed to produce an output function that gives relatively large values for examples from the positive class and relatively small values for examples belonging to the negative class [4].

V. IMPLEMENTATION AND RESULT

Support Vector Machine is highly efficient tool used for classification and regression. Histogram equalization is used to adjust image intensities to enhance the contrast. Frames are extracted from the input video, every alternate frame is preprocessed using Histogram Equalization then Gabor filter is applied to extract features. The size of the Gabor mask which is used here for the purpose of feature extraction is 7 x 7. The equation of the Gabor filter is described in section III. The parameter v and w determines the size and orientation of the Gabor filter. The value of parameter v varies from 0 to 4 while value of the parameter w varies from 0 to 7. Then the real part of the Gabor mask is convolved with the input frame. So five different Gabor features for each frame are obtained, those are shown in Figure6.

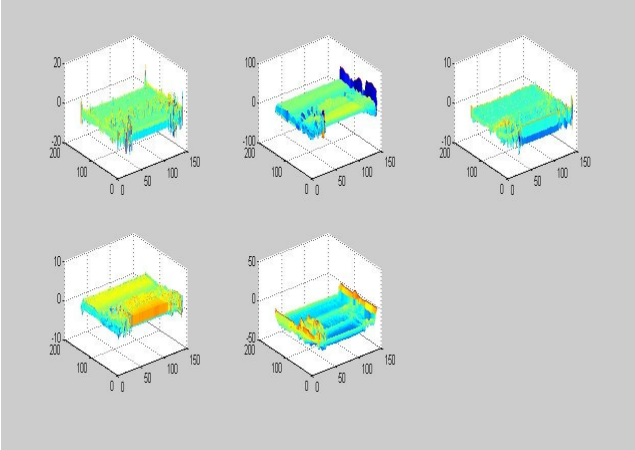

Figure6: Result of Convolution with different Gabor Masks

Those features are resized and arranged in one array for one entire video. For the purpose of the classification open source tool SVM-light is used. SVM builds a model using example file which is the representation of the features as a point in a space. For the test examples prediction is done using this models and stored in the output file. Classification rate is calculated using those predictions. For both Abnormal and Normal events 50 such videos are given as an input for training purpose and 20 videos are given as an input for testing. Through this proposed method approximately 85% accuracy is achieved. This Approach is more efficient in case of local event detection.

VI. CONCLUSION

Abnormal Activity Recognition receives more attention since few years as security in private or public places becomes more critical issue. Histogram equalization is the best way to enhance the contrast of the input frames. For feature extraction and motion analysis Gabor filter is vastly used. Extracted features are found to be unaffected by illumination changes and noise. Support Vector Machine is one of the most dominant tools used for classification and regression. In case of local events like theft near secure areas, abnormal behavior in ATM proposed method achieves good classification rate.

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